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Memorandum

OC-M-70-514

TO : Chief, Support Services Staff

DATE: 4 AUG 1970

FROM : Special Assistant for R&D, OC

SUBJECT: Future Trends in R&D

25X1 1. Attached for your information is a copy of a paper titled "Some Implications of Technology for R&D Program Planning" by [REDACTED] Chairman of the Agency R&D Board. This paper indicates trends in the future for R&D.

2. It may be useful to let this paper have fairly wide routing. Many areas of direct concern to the Support Directorate are not discussed in the paper, but it can provide a springboard for discussion of the role of technology in problems of more immediate Support Directorate interest.

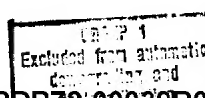


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Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

MEMORANDUM FOR:

1. The attached paper is a draft intended to illustrate a sort of approach which I believe might be useful in identifying and assessing trends pertinent to the structuring of an effective R&D program. The draft is sketchy and frequently overdrawn for emphasis.

2. I solicit your comments for change in organization and content. Ultimately, such a paper which could be used as a starting point for what would hopefully be a continuing dialogue with ONE and others to solicit and evoke the best possible trend estimates in terms that would be useful in shaping and directing the R&D program.

[Redacted]
Special Assistant to the
DD/S&T

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**Some Implications of Technology
for R&D Program Planning**



July, 1970

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INTRODUCTION

The objective of this paper is to illustrate the impact of technology in several areas--political, social, economic, and military--giving emphasis to special technological fields which appear to be particularly pertinent with respect to their influence on the future to derive some implications with respect to the Agency and, in particular, to the content and organization of the R&D program plans. Developments in Japan will be considered to illustrate the potential which may exist for currently underdeveloped nations to grow rapidly through the exploitation of technology.

The pervasive and irresistible force which is changing the world and the affairs of men at an increasing rate is technology.

The pervasive nature of technology is frequently overlooked. While the role of technology is apparent in activities such as space programs, the relationship between technology and agriculture, for example, is not so clear. There is, however, a synergistic coupling, so the impact of technology in any one field is extended by related developments in

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other fields. In the case of space and agriculture, for example, the development of better weather forecasts through the employment of satellites will result in improved crop yields. In addition, however, some abilities with respect to forecasting of crop yields may also be achieved through the use of satellite reconnaissance. Similar kinds of relationships exist throughout technology. The improved instrumentation in technology, particularly in electronics, has had a very significant effect upon the medical sciences providing instrumentation for experimentation and analysis hitherto impossible. Eventually progress in science expands the kinds of alternative actions which become technologically feasible in industry, commerce, social affairs, etc.

Technical capabilities far in excess of well defined needs have been apparent since the beginning of the century, but most particularly since World War II. Einstein, for example, observed, "Perfection of means and confusion of goals seem to characterize our age." (1)

The growth of science and technology has received much attention. Roughly speaking, the number of scientists and engineers in the western world has doubled about every 12 to 15 years for the last 300 years. The same rate of growth has also occurred in scientific and technical literature. What is not generally appreciated, however, is that this very

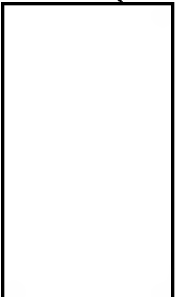
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rapid growth has finally reached a point where it can no longer continue for an extended period of time in the more developed nations--say the United States and the Soviet Union.

Currently, scientists and engineers comprise approximately two percent of the eighty million people in the labor force of the United States. In five more doubling periods--60 to 75 years--well over half of the labor force would be scientists and engineers if the present rate of growth were to continue. This is obviously infeasible. While an upper limit remains to be established, the important fact, nevertheless, is that the present total population of scientists and engineers is now significant in terms of magnitude with respect to the total labor force.

Two characteristics of research and development may be more important in the long run than the direct products produced through R&D activities. Change and rate of change become more and more significant. Change is evident in the development of new ways to do things as well as in the refinement of existing products. As the size of the R&D community, and as the technology becomes increasingly abundant, the rate of change also increases. Ultimately, these changes require rethinking about the way organizations function since the changes rarely fit neatly into existing patterns.

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The difficulty of categorization has certainly been a

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factor leading to the neglect of the impact of technology on established fields. Because technical developments often fail to fit well within classical lines, there is confusion and difficulty in accounting for technology in analyses of political, economic, and other types of studies. In the field of economics, for example, some of the more ambitious writers have chided their colleagues for failing to properly consider such things as invention in their studies. In the following sections only the more obvious areas of impact will be mentioned to suggest some approaches which might be taken which would be of significance for intelligence and R&D planning.

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POLITICAL

World law may be strengthened as a potentially effective force which may be needed to insure against irrational actions on the part of individual nations. Norman Cousins recently stated:

The major obligation of national governments, as John Locke saw it, was to respect and protect the lives, properties, and culture of their peoples. This was a major aspect of the social contract. But this contract is now beyond the means of any government to fulfill. For no state today can protect its people." (2)

The developments leading to the condition which Cousins describes are technological. While nuclear weapons were primarily for military purposes, the impact has been important politically. As typified by nuclear weapons, the side effects of the many technological developments are both pervasive and extensive, and in many instances technology tends toward the disestablishment of existing organizations. Technology may not "burn it down," but in terms of evoking basic changes in political as well as other organizations it may well have no peer. (3)

The forcing nature of technology upon political organizations can readily be appreciated in considering the air transportation problem. At the domestic level, a variety of Federal, State, and local organizations, together with their laws, constitute a substantial impediment to the most effective implementation of a comprehensive and efficient air transport system. When only a few aircraft

were flying and only a few passengers were using the airports, the overlapping jurisdictions created no great problem. Now air travel accounts for 70% of the passenger traffic miles travelled in the United States, and the size of the operation means that arterial highways and other elements become critical in the operation of the system.(4) Advancing technology has provided a more attractive method of transportation, namely air transportation, which is in turn causing disruptive pressures upon existing political organizations. The domestic air transport problems have their counterparts, of course, on an international basis.

Technology has provided the means for increased production, in order to supply the wants of an expanding population. The attendant pollution is now a major political issue. By and large the existing political structures are not well adapted to dealing with these kinds of problems since they fail to respect political boundaries and jurisdictions. Almost any pollution problem involves local, State, and Federal agencies--frequently more than one at each level.(5)

Air transportation and air pollution although far less dramatic than the impact of nuclear weapons are cited merely to illustrate the fact that existing political structures are by and large not suited to dealing with the problems created by technology--regardless of the type of technology or the political level involved--and intelligence interests

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may thus arise in hitherto neglected areas.

The desires which technology promises to fulfill provide a great incentive to proceed with the development of new programs--space programs, etc.--but in an increasing number of cases the cost of the programs are too great for any one nation to be able to afford the program on an exclusive basis. Information from some satellites--such as weather data--is already being shared on an international basis. The Earth Resources Technology Satellite, "ERTS" will extend the data base well beyond weather alone and may provide information of importance to commercial fisheries, agriculture, mining, shipping, etc. Although ERTS remains a United States program, ultimately some questions will be raised about the use of U.S. funds and talent to collect, reduce, and communicate data which is of interest to non-U.S. nations gratis.

These programs, and other programs of similar nature, have obvious potential for the development of international agreements requiring the participating nations to give up at least a degree of their sovereignty in order to share in the benefits obtainable only through cooperative action.

A particularly striking example of an international organization formed to exploit technology is INTELSAT. Membership in the International Telecommunications Satellite Consortium increased early in 1970 to 75 nations. During

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1969 the number of nations actually served by the satellite communications increased from 27 to 52. The Communication Satellite Corporation (COMSAT) serves as the operator for INTELSAT. COMSAT, however, is subject to the jurisdiction of four separate Federal entities. Needless to say the corporation may at times be hindered by disagreements with respect to policy among these four entities. Since the satellites which COMSAT operates are procured on a competitive basis, political reorganization in order to make the corporation more efficient may be required if foreign nations become able to do an equivalent or better job at less cost to the consortium.

The impact of technology in the political area is not confined merely to the structure and relationships of political organizations. The problems that are generated extend all the way to political/social borders and matters pertaining to individuals' rights as, for example, the transplantation of organs and the invasion of privacy through various data processing mechanisms. In examining the legal problems associated with technology, one writer goes so far as to argue that scientific and technological developments will have more control over the nature and direction of public policy than political and legal doctrines. (8)

Although the research and development program in the United States is largely unstructured, this is not true in

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all nations, and as technology becomes of greater political significance, substantial changes may occur both in the United States and elsewhere. France, for example, has arranged their research program in terms of eight major efforts such as human sciences, life sciences, housing, urban planning and transport, etc., and plans to increase the R&D investment from 2.2% of the Gross National Product in 1971 to 3% by 1975, with the goal of 3.5% by 1980. 17% of the expenditures would be for military purposes.(9).

From a political point of view, then, technology in the form of gunpowder initiated the demise of political and social organizations built around previously impregnable castles, and, currently, in the form of nuclear power threatens the existence of the nation-state. New alignments and new organizations are forced by the necessity to accommodate new technologies with which existing political structures are inconsistent. Political theory as well as political organizations have clearly not kept pace with the growth of technology. Kingman Brewster, Jr., speaking on the threat of impatience, and citing complexity as one of the targets of impatience, recently stated the basic concern, "....The structures of a technological society seem hopelessly complicated, beyond the reach of most, seemingly unmanageable even to the few who do grasp the levers of power."(10).

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SOCIAL

Warren Bennis and Philip Slater described the temporary society primarily in terms of the physical movement of people from place to place, and the attendant disruption of social ties. As the Post Office well knows, approximately 20% of the addresses in the United States change each year. Technology has been primarily responsible for this change from a relatively fixed to a highly mobile society and the associated serious social implications.

A social change which appears is less well appreciated, but may be even more significant than physical mobility, is the rate at which technology is making many jobs obsolete--and creating new jobs in their place. It is difficult to overestimate the impact which technology has on skills requirements in the labor force. In the United States the introduction of new fertilizers, modern methods, and new machinery on the farms has resulted in a tremendous increase in productivity--at the same time drastically reduced the need for unskilled labor on the farm. This general trend can be observed in a number of areas. Between 1947 and 1964 the manual workers in the labor force fell from 41% of the total to 36% while white collar workers rose from 35% to 44%. In general, unemployment has been concentrated among those with little education or skill, while employment has been rising most

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rapidly in those occupations generally considered to be

the most skilled and to require the most education. (11).

Displacement from obsolete jobs, although originally beginning at the lower levels of employment, is not restricted to this area. It is increasingly clear that the use of computers in new management systems has made serious inroads upon the normal activities of middle managers. More recently, some professional opinions may be compared with analyses using vast data bases. For

example, medical diagnoses may be compared against probabilistic estimates developed through computer techniques.

The social unrest created by these trends cannot be assuaged by attacking the machines--as the Luddites learned. Innovations in the social area comparable in scope and timeliness to those which are occurring in the technological area are needed--but lacking.

The pervasive nature of the impact of technology upon social institutions can readily be illustrated. The technological feasibility of population control on a broad basis through a variety of techniques has been clearly established. These developments have had a severe impact upon issues which are basic to many social institutions, especially churches. The displacement of the agricultural worker from the farms has been previously mentioned.

R. Buckminster Fuller has illustrated the magnitude of

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technological advance in terms of the energy available to the average citizen. 30 years ago he calculated the total energy generated in the U.S. as equal to the muscular energy that would be generated if every American had 153 slaves working for him. Today a similar calculation would indicate about 500 slaves for every American man, woman, and child. (12). The ways in which the "slaves" are used differs widely. Considering only communications, for example, there simply are not enough women in the country today to operate the telephone switchboards. On the other hand, although productivity in the private sector has increased on an average of 32% in the last 15 years, the productivity of the postal worker has increased only 2.3%. (13). An increasing population which demands more and better services must look to automation which can be achieved through the implementation of technology.

The advances which R. Buckminster Fuller illustrated had to do with physical power. The growing trend today in technology has to do with brain-like power. More sophisticated ways of manipulating larger and larger data files has explosive potential in applications which have yet to be given serious attention. As an example, the accumulation of vast amounts of personal data in computer files is seen by many as a great threat to privacy. However, it may be anticipated that the convenience of automatic credit card shopping will be chosen at the sacrifice of a degree of privacy to the data required

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in order to make such a system operate. The erosion of privacy has about reached the point where privacy is now a lost cause. (14). Automatic credit transaction files, coupled with others, could conceivably be operated to provide a near real-time census, give rapid indications of trends in consumer spending, incidence of diseases and illnesses--and a host of other "intelligence" whose potential is not actively considered because it is not yet at hand.

For some reason the requirement for continuing education does not seem to be as clearly perceived as the fact that technology is making many current skills obsolete. The half life of engineers has been variously estimated to be between 10 to 15 years. Obsolescence in other jobs may range widely depending upon the technological impact. If it becomes true, however, that a real dropout is one who does not continue education actively after graduation from high school or college, then the already rapidly increasing expenditures for education can be expected to continue. Government costs are growing most rapidly at the State level, and at the State level the increased costs are primarily for education. It is interesting to note, however, that R&D expenditures by State government agencies are not strongly directed toward improving the efficiency and effectiveness of education but, rather, "In 1967 and 1968 over 40% of total State expenditures for research and development went to the area of health

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and hospitals, and 25% for natural resources; approximately
10% went for highway research and development. Other
areas receiving R&D support by States were education.
(10%)..."(15). The Post Office should provide some warning
signals about simply adding more people to solve growing
problems.

In addition to the effects of the technology upon
society, the rapidly increasing numbers of scientists
and engineers in the total population may also be expected
to have substantial effect. In the 16 year period from
1950 to 1966 total employment increased by only 24% while
the numbers of scientists and engineers in the United
States increased by 156%. The population of scientists
and engineers as a percent of total employment changed
during that period from 0.9% to 1.9% of the total employment.
Further, only a portion of the scientists and engineers
are engaged in research and development--varying from
28% in 1950 to 37% in 1966. (16). Clearly, the rapid
growth of scientists and engineers as a percentage of
the total employed population will not continue to increase
at a rate substantially greater than that of the employed
population as a whole. But at least in the immediate
future an increased presence in a variety of different
positions by people having scientific and technical educational
backgrounds may have a substantial sociological effect. In
a survey of 6,000 executives in industry by the Harvard
Graduate School of Public Administration, it was determined that

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only 35% of the executives who were 55 years of age and over had backgrounds in engineering and science. This increased to 40% in the age groups 50 to 54: to 45% in the age group 45 to 49: to 50% in the age group 40 to 44; and 55% in the age group 35 to 39.(17). In time, then, as the older executives retire an increasing proportion of executives in industry will have engineering and scientific backgrounds. This growing domination in executive positions is further evident in executive openings during the period July to September 1968. Of the 9,810 openings during this 11 week period, 47% were for openings for engineering and scientific positions. These trends in the United States are not unique.

The social changes which have been made through communications, through the growing number of scientific and technical personnel in the labor force, and other factors including loss of privacy and potential widespread population control, would appear to be of less significance to the future than the experimental developments and the increasing body of knowledge pertaining to memory and how the mind works. Although very preliminary in nature, significant developments have occurred indicating that some form of knowledge or memory may be transmitted through chemical processes--that chemicals or drugs may be used to both improve or to inhibit long and short term memory which may be further reflected

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as influencing learning ability. These programs, taken together with increased knowledge regarding the use of artificial organs and genetic engineering, hint at the elimination of some current social problems--and the development of questions of ethics and morality in their place. (18).

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Although the rich do get richer and the poor do get poorer, the poor get poorer only in relationship to the richness of the rich. Actually an increase in productivity, or to put it another way, an increase in Gross National Product per capita is anticipated among virtually all the major populations and countries of the world. This increase in abundance or increase in productivity is achieved for the most part by the adaptation of new technological methods and devices. While precise estimates relating the growth to the expenditures in science and technology do not exist, certainly science and technology contribute in a major way. This is not particularly surprising since some special studies have shown from time to time that a particular type of technology--inventiveness and entrepreneurship--are highly sensitive to the perceived opportunity to benefit economically on the part of the inventor or the entrepreneur.(19).

The rapid impact which new technological industries can have may be appreciated by considering that in 1945 the television, jet travel, and digital computer industries were commercially non-existent, while in 1965 these industries contributed more than \$13 billion to the Gross National Product, and an estimated 900,000 jobs, and importantly, affected the quality of living.(20)

Because of high labor costs and other factors, it

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is new technology that is responsible for the products which result in a favorable balance for the U.S. in international trade. Exports of cotton and wool fell from \$197 million in 1956 to \$125 million in 1965, while during the same period exports of synthetics rose from \$158 million to \$241 million.(21). Royalties alone from technical know-how amounted to \$514 million in 1965. Consider a single area, the aerospace industry, in which the United States has a superior position. During the ten years from 1960 to 1969, the total U.S. trade balance fell from slightly over \$5 billion to slightly more than \$1 billion, but aerospace exports alone rose from \$1.7 billion to \$3.2 billion giving a rising trade balance in this field from \$1.6 billion to \$2.9 billion. Thus, the aerospace trade balance, as a percent of the U.S. total, rose from 31% in 1960 to 240% in 1969.(22).

As technology becomes increasingly important both in terms of new products and in the development of new techniques for the production of existing products, a better understanding of the economics of technology will be needed.

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MILITARY

The impact of technology on military operations became obvious in World War II with the development of the nuclear bomb. Developments in aircraft and radar, along with many other innovations, had a significant effect upon the outcome of this conflict. Operational intercontinental ballistic missiles, a more recent development in the last ten years, have captured an increasing amount of public interest as well as an increasing share of the military budget.

Of special significance is the temporary advantage which technology provides in terms of weaponry. The edge which any nation has over any other in scientific areas is small, but technological developments may be implemented only to the degree to which the superior country has a supporting industrial or technological base required for weapon fabrication. Nuclear weapons have been developed by the Soviet Union, France, and Communist China, in addition to the United States. The rate of proliferation, however, may now increase dramatically as nuclear material processing technology proliferates because of interest in this technology for processing material to be used as fuel in power plants. For example, Ultra-Centrafuge Netherlands, NVF., is a new company created to develop and exploit the gas centrifuge method of enriching uranium. This Dutch, British, and

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German combine may be extended to include Italy and Belgium, and Japan may also be investigating such a development.

(23). This situation illustrates a maturing technology and fabrication ability becoming widely available concurrent with a basic need--more and cheaper power.

Less dramatically, but perhaps more significantly, the variety of sensors which may be used to obtain vital information for tactical operations--low light television cameras, infrared devices, seismic sensors, etc.-- may be coupled with automatic data processing equipment to provide a tactical Commander with a very rapid assessment of his own and his enemy's alternatives. With higher battle field mobility already an accomplished fact, the time-consuming development of intelligence must be reduced by the use of automated techniques. Ultimately this could develop into a trend toward automatic battlefield operations with various weapons targetted and operated remotely. In effect, technological developments in sensors have produced a tactical information explosion which seems likely to revolutionize tactical doctrine as well as equipment. Highly mobile fire power from helicopters has frequently been credited with significantly reducing American casualties in Vietnam. Although very expensive in terms of dollars, public pressures and other factors are such as to make such expenditures preferable to casualties.

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In military operations as well as in the field of political science, economics, social activities, the spectrum has been widened by technological developments. While an all out nuclear exchange remains a possibility, warfare in a variety of hitherto unprecedented forms in terms of the weapons employed are now extant. Again, as in other fields, what will be done with the spectrum of alternatives, versus what can be done is highly uncertain. In the case of the Israeli/Egyptian conflict, for example, a short and intensive campaign exercising modern weapons to the utmost has been followed by an extended period of a very different form. ✓ In Southeast Asia, on the other hand, the technological potential of U.S. Forces has not been fully exercised. Under different circumstances, as in Czechoslovakia, overwhelming military superiority has achieved immediate political goals virtually overnight.

Because of the continuing involvement of the United States in Vietnam it may be difficult to objectively appreciate and evaluate the variety of military actions which might be undertaken. Technologies which may be normally associated with peaceful applications, but which have not yet been exploited for military purposes, may not be perceived in terms of their ultimate potential. Weather modification might be employed for military purposes on a local or regional basis. Lasers have already been used for a variety of

military purposes, and might be used as weapons either now or in the near future.

To amplify Norman Cousins view about the ability of the most powerful nations on earth today to defend its people, technology would seem to have broadened the spectrum of attack to such an extent that the costs of an adequate defense are prohibitive for any nation. [There is no acceptable defense in existence today against an all out nuclear attack-- nor is there an acceptable military posture to preclude incidents of the Pueblo-type--and the impotence of modern military forces in situations such as Vietnam has also been clearly demonstrated.]

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JAPAN (24)

Japan provides an exceptional example of what may occur when technology is exploited in a compatible environment. Although occupied until 1952 the rate of growth in the Japanese GNP was about 9% per annum in the 1950's and in the 60's averaged approximately 10%, increasing to 13 to 14% more recently, and in 1968 reached 14.9%. Some sources estimate that an 11% growth rate may be maintained for at least the next five years.

Although Japanese expenditures on R&D amount to 1.8% of the Gross National Product--which is somewhat less than the amount spent in other major countries--75% of these funds come from industry, whereas in most other countries approximately 60% of the funds come from the Government. In electronics, in particular, 98% of the R&D funds are provided by industry which contrasts sharply with the 35% of the electronic R&D funds provided by industry in the United States.

Science and technology manpower as a portion of the total labor force of Japan rose from 13% in 1955 to 22% in 1963. Further, the science and technology manpower was concentrated in heavy industries.

As is frequently mentioned, of course, Japan has not had to devote a substantial part of its wealth for defense expenditures. Expenditures for defense generally run something

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under 1% of the Gross National Product, or approximately
8% of the Government budget.

Although commonly regarded as a great exporter, the Japanese internal market is very large, and the Japanese exports total only about 10% to 12% of their total output. This is about half the export ratio for West Germany and Great Britain. Further, although highly regarded in terms of electronics and optics, Japanese exports are now concentrated in the heavy industries--the leading areas being iron, chemicals, and motors. Nevertheless, the production of colored television sets in Japan in 1970 is estimated at six million--more than the estimated U.S. production.

A good deal of Japan's ability to grow through the exploitation of technology and modern methods has been due to the political stability of the environment. For example, when Eisaku Sato became Premier, 13 of the 18 Cabinet members were replaced, but there were only slight shifts in policy. In addition to political stability, the unions in Japan tend to be vertically organized. West Germany's unions were also restructured in a vertical fashion after World War II. Only the United States and Great Britain still suffer the impediment of horizontal craft unions' objections to the introduction of innovations in manufacturing, etc. Whenever a product line is no longer profitable, or whenever union demands increase the labor cost to a

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 point where the necessary margins cannot be achieved, retraining of employees and retooling of the plant may be undertaken in Japan with minimum objection in order to move into more profitable areas.

Science and technology also tend to be more on top and less on tap than is characteristic in many other countries. The head of the Science and Technology Agency, which was established in 1956, holds ministerial rank and, in fact, the present Premier at one time was head of that agency.

The realistic accommodation to the nature of technology and the rapid rate of change associated with it is also reflected in the tax structure. For example, a depreciation of 95% is allowed on laboratory equipment for research and development in the very first year of its use in accordance with laws passed in 1964. This rapid write-off allows the R&D entrepreneur to quickly recover his capital in these areas and strongly encourages the use of modern plant equipment.

AGENCY IMPLICATIONS

Those who produce consumer products are acutely aware that the half life of the products they produce grow shorter and shorter as technology replaces the existing products with new and different entities. In order to remain effective, a producer must come to terms with the shifting market. This needs to be well recognized by intelligence organizations, but the trend seems to be more directed toward doing yesterday's important job better. For example, has the relative importance of maintaining files on individuals with respect to the importance of keeping files on the development of technologies changed? Should a major shift be made from preoccupation with nuclear weapons and guided missiles to viruses and genes, or to put it another way, from physics to biochemistry? Harvard scientists announced last December that they had isolated a gene for the first time, and Nobel Prize winner Gobin Khorana announced last month that a team which he had led had created a gene from simple organic chemicals. (25). Should this development rank in significance with the achievement of a chain reaction in the development of nuclear weapons? Precise intelligence applications associated with such developments may be somewhat obscure, but careful attention should certainly be paid to the "shifting market" in both broad areas of concern as well as internal capabilities. More things will become more important in more places.

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Technologies which may have serious implications with respect to the United States grow increasingly---and rapidly--and come within the capabilities of an increasing number of nations. As mentioned, more than a little interest with respect to gas centrifuges which may be used to enrich uranium in order to obtain weapon grade fuel exists in Germany, Holland, Italy, Belgium, Japan, and certainly other nations. The problem which this typifies is how to adequately keep track of an increasing number of potential threats throughout increasingly expanding geographical areas.

Since the source of threats may diverge considerably from the traditional military one, some intelligence interests may shift toward industrial and away from military activities.

In fact, the potential actions of some firms may be of more significance than the actions of some countries.

Catapillar Tractor, General Motors, major non-U.S. firms, and the like are now the organizations on which the sun never sets. If society continues to become disenchanted with what the nation state political arrangement can provide, the importance in intelligence of industrial organizations may significantly increase.

Certainly a primary implication is that any intelligence organization must become and remain increasingly adaptive.

Implicit in this is the need for continuous education both formal and informal. If, for example, information storage

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and retrieval activities are to be automated, it is important to recognize this sufficiently in advance so that the necessary personnel may be educated to have the required skills when needed. The same situation exists with respect to intelligence analysts and similar examples may be found in virtually all Agency operations. It is a well established fact in technology that the most productive people are frequently those whose abilities are not restricted to one particular discipline. Their special contributions come through playing not on the pure "keys", but on the interdisciplinary "cracks" between the keys. For instance, a solution to a problem may not be found, say, in biology or in physics, but in biophysics. To an increasing degree, then, continuing education must become a regular part of doing business and accommodating change.

here!

Given limited manpower and limited funds, the ability to move on to new and developing areas is dependent upon withdrawing from current areas of interest. A tendency to know more and more about less and less is certainly inconsistent with the task of being alert and effective to expanding fields of activities. If the CIA is to be a ^{front} ~~forerunner~~ in the Intelligence Community, then some work will have to be terminated or shifted to other organizations--when that work becomes routine. Since people now feel most confident and secure in the areas in which they are

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most expert, conventional ideas about career patterns and extensive specialization may have to be revised so that confidence can be achieved in a chronically changing skill environment.

There is a great need for studies that can identify important new intelligence targets in a timely way. In view of the rate at which things are changing and new devices are developing it is safe to say that some primary sources of threat have not yet been invented. This is no excuse, however, for not analyzing carefully the information that is available.

The difficulty of keeping up with a rapidly changing technology and its implications in all areas can scarcely be underestimated. For example, the data in the Science Journal and Scientific American which were used extensively in the section on Japan differs in many respects from predictions made only a short time before by Kahn and Wiener in The Year 2000. Kahn and Wiener estimated that Japan would reach the 1965 U.S. GNP per capita of \$3,600 in 22 years, i.e., 1987.(26). The prediction in the American Scientist, however, is that if the present rates continue, the GNP per capita in Japan will equal the GNP per capita in the United States in 1988. Elsewhere Kahn and Wiener made a medium forecast that the Japanese GNP would equal or exceed that of West Germany in 1975, whereas, in fact,


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the Japanese GNP exceeded the West German GNP in 1968.(27).

In part this stems from a use of a growth rate for Japan by Kahn and Wiener of 6.8%. Although this may be reasonable in terms of the long term nature of Kahn and Wiener's interest, the much higher rate which has existed in the past few years is obviously significant.

 To be more effective, then, it may be necessary for the Agency to loosen up or disestablish to achieve the necessary degree of adaptability in order to organize differently, focus differently, and operate differently as new areas become important and old areas decrease in importance at an increasing rate. How else can one come to terms with a shifting market?



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RD&E IMPLICATIONS

The impact of a rapidly changing and expanding technology are especially severe in the development of techniques and devices for intelligence collection, communications, information processing, and in other fields. The expanding and changing technology is also becoming more sophisticated which means that more complexity must be anticipated. If the intelligence targets shift rapidly it also means that the R&D "plant", as well as the skills possessed by the R&D personnel, must be rapidly depreciated in terms of their effectiveness.

It is easy to identify a number of situations in which current efforts reflect more what can be done than what should be done. Clearly, at this time, the potential for rapid proliferation of a nuclear capability exists, but only a very limited amount of thinking is devoted

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How

seriously should this be taken? Is there an R&D problem?

Lasers have a definite weapon potential and are far more advanced than the nuclear technology was in 1939, but

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This is not a new problem--it has been extant for some time, and it is clearly known that Soviet laser technology is generally superior to that of the United States. What about weather modification? What about biochemical areas? What about chronic information needs on nuclear weapons diagnostics--will old problems yield to new techniques?

Business as usual will clearly not suffice. More attention must be given to the identification of potent technologies and sciences and a wider range of risks must be accepted in terms of developing appropriate reconnaissance or surveillance equipment in order to achieve adequate lead time. More expense will no doubt be entailed and completely new systems for communications and analysis must be developed. In order to design, develop, and operate this equipment, changing organizational patterns must be anticipated. Increasing use of task force type of groups and broad participation by many individuals in a number of areas will be required. Very deliberate decisions regarding what will be done and what will be left undone must be made in view of the great importance of obtaining the maximum benefit from the resources which may be available.

To an increasing degree scientific and technical personnel must be concerned not only with the R&D activity but also in the estimate of what impact technologies may have in the future. Some of the officers who majored in the physical sciences should be back in college taking courses in life sciences, cybernetics, and in other developing

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fields. They should also be taking some courses in political science, sociology, and similar fields in order to improve their understanding of these areas and their ability to communicate with experts in these fields. Techniques such as DELPHI which accommodate a multidiscipline approach to forecasting will no doubt find increasing use as the scope of many problems become broader and broader. In urban problems, for example, Jay Forester has convincingly illustrated the fact that intuitive solutions may not be very efficient and, in fact, he finds that large systems tend to be counterintuitive. To be effective, then, techniques such as DELPHI or others require the participation of individuals who are broadly skilled, and the development of system models which may be used to sharpen and improve the estimative process.

More automation, more pre-selection of alternative actions under a richer range of situations, more interactive processes organizing and analyzing data from increasingly diverse sources in near-real time, etc., etc. Reluctantly, perhaps, developments of end devices, communications, processing, control, and other elements which sum to what must eventually be recognized for what is is--operational cybernetics.

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Peter Drucker cites this development as a significant fact in the communications gap between youths and adults:

And no government, whether its territory spans the continents or is smaller than one city block, can any longer discharge the first duty of government: protection from, and defense against, attack from outside. It is perfectly true that most of the new "ministates" are political absurdities, defenseless against the threat of instant annihilation. But so are the "super-powers" in this age of nuclear "overkill." With nuclear weapons being easy to make and, in effect, available to the smallest and weakest country, there is no "defense." There is only--questionably-- "deterrence" by the threat of retaliation. But if government cannot defend its people, the first reason for the very existence of government has gone.

This may be regarded as gross exaggeration. It certainly is not the picture the older generation still sees. But it is, increasingly, the reality. It is the situation to which we react. And the young people, who are not, as we older ones are, influenced by the memories of our love affair with government, see the monstrosity of government, its disorganization, its lack of performance, and its impotence rather than the illusions the older generation still cherishes and still teaches in the classroom.

The Age of Discontinuity, pp.224-225.

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Inevitability of Democracy" and "The Death of Bureaucracy"
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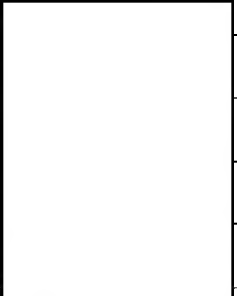
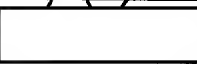
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